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Student Project Handbook

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STUDENT PROJECT HANDBOOK

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STUDENT PROJECT HANDBOOK

Preface

Student projects became an integral part of Alberta biology courses in September, 1971, and since then reactions to the value of projects and related activities have become increasingly positive.

Since problems regarding the selection and management of student projects have caused concern for teachers and students, the guidelines presented in this handbook have been prepared to assist in clarifying some of these concerns.

Definition

The word "project" has been taken from the general English vocabulary and applied to the educational field. Because the term has a variety of meanings in general usage, it follows that it has a variety of connotations when applied to certain concepts in education. Some teachers simply define a project as a student-oriented activity, others as a laboratory exercise, others as a library search of literature. However, a project often includes all of these and more. Webster's New International Dictionary defines a project as "1. a plan or design; a scheme; proposal. 2. a planned undertaking, specifically a definite piece of research. 3. a task or problem usually calling for constructive thought or action by the student and involving the learning of a phase of schoolwork."

John Stevenson defines a project as a "problematic act carried to completion in a natural setting." In definition several aspects should be noted. First, there is an act carried to completion or near completion as compared to the passive absorption of information. In other words, projects are activity-oriented. Second, there is insistence upon the problematic situation, demanding reasoning rather than merely the memorizing of information. That is, projects must involve problem solving. Third, by emphasizing the problematic aspect, the priority of the problem over the statement of principle is clearly implied. Stevenson seems to be stressing that projects should simulate real life problems or investigations.

In these definitions, the predominant idea is that of the student being actively involved in some sort of investigation. Projects imply a teaching-learning activity in which the student learns to learn on his own.

Rationale for Student Projects

The Alberta Program of Studies for Senior High Schools indicates that a student project is required for completion of each course in biology. One objective of high school biology is to develop the ability of a student to carry out successful independent study and learning. Another objective is to develop an understanding of and an appreciation for the methods used by scientists; that is, the processes by which scientific knowledge is gained.

Jerome Bruner in his book On Knowing (1965) states: "Of all man's possessions, his most valuable is the knowledge he possesses. But of all his knowledge, the most priceless and personal is that which he has discovered for himself." The nature of project activities requires situations and problems to be analyzed, investigations conducted, information evaluated, hypotheses synthesized and tested, generalizations formed and, ultimately, predictions made. Development of these skills demands that the learner have an active role in an investigation. Since a learner cannot acquire all the knowledge and understanding during his school years that he will need throughout life, the schools must teach him how to continue to learn on his own after he leaves school.

Purpose

The purpose of a project is not to discover unknown scientific truths, but rather to lead students to independently use some of the processes by which scientific information is obtained. The process of arriving at an item of scientific information becomes more important than the information obtained. Effects of such an approach are an increased interest in science and an increased ability to think logically.

The purpose of these guidelines is to encourage and assist teachers and students with limited experience in carrying out study projects. No one should hesitate for fear that their contribution will be insignificant or that their work will be inadequate. Progress is made only through effort and experience. Students usually accept this challenge willingly but it is imperative that guidance be given in planning and scheduling of class time.

Types of Projects

1. Research Projects

(a) Experimental - A particular problem is identified and the student(s) collect data to resolve this problem.

(b) Literary - A search of literature is made to resolve a particular problem or to learn about a particular concept or issue.

2. Case Study Projects

The intent is to have the student, through the study of relatively simple factual material, follow closely from the original writings the way in which a scientist tried to reshape his materials and ideas to reach some major conclusion. J. B. Conant has called this "looking over the shoulder of the scientist at work." The student should recognize through his own activities and experience the difficulties and procedures of the scientist at work.

e.g. Pasteur's studies of fermentation
Fleming's studies of moulds and penicillin

3. Descriptive Projects

A student uses observation skills to accurately describe a particular situation or set of interrelated situations to gain a better understanding of some aspect of nature.

e.g. Behavioural study
Interrelationships in nature
Man's political, social and economic influences on a particular environmental problem

4. Survey Projects

A student gathers quantitative data to:

(a) Provide a more factual base to show that a particular problem exists.

(b) Describe an ecological area.

e.g. Identification of plant and/or animal species of a particular habitat
Preparation of a questionnaire and/or interview for collecting information from the community relating to a particular problem
Population studies

5. Technical Study Projects

The student attempts to duplicate or use technical or assay techniques to learn about some quantifiable aspect of a problem.

e.g. Use chemical assay methods to determine levels of gases in solution to establish effects on plant and animal life.

Another aspect may be that the student(s) attempt to devise instrumentation to assist in the collection of particular kinds of data or to do particular tasks relating to a specified problem.

A project, depending on its nature, may be classified into one or more of these groups or it may fit into some other category, depending upon the creativity of the investigator.

Organization

The amount of class time to be spent on projects will be contingent upon many factors which the teacher will have to take into consideration.

If students work in groups, class time should be spent on projects so that the students may work together. Advantages of grouping may be that less equipment will be used, there may be fewer organizational problems compared to independent work, individual tasks can be shared amongst members of the group and the teacher will be present to consult with students.

The following factors need to be considered before deciding on group projects. Do the students have an adequate background knowledge of biology to work independently on a topic of their choice? Will there be enough class time, school space and laboratory equipment for the students to do the project in school?

It is important to discuss with students the problems they may encounter while conducting their projects. Some time should be set aside each week to handle this concern. Problems may be discussed with individuals or groups while the rest of the class works independently.

Set a reasonable amount of time aside if students are to report orally on their projects. While each group or individual is reporting, the remainder of the class could be evaluating the project on the basis of guidelines set up by the teacher.

Problem or Topic Selection

Under certain circumstances it may be advantageous for the teacher to select the topic(s) for the students. Such selection allows the teacher to take into consideration the ability and maturity of the students as well as the availability of time, space, equipment, library and other resources.

Student selection of the topic has advantages in that the student will be working on a topic which is of particular interest and the difficulties involved in defining a problem will become apparent. If students are to select a problem or topic, make sure to set a deadline so that the project can be completed on schedule.

If students are to select their problems or topics with a minimum of time wastage, the teacher can help by giving the students certain guidelines:

1. The problem or topic should take into account the student's background knowledge and ability. It should involve only those skills and cover an area which can be mastered within the allotted time.

2. The problem should fit the facilities that the student will have at his command, whether they be school laboratory facilities or those the student can provide for himself.

3. The project should fit the school's as well as the student's time schedule. If a student does not have much free time, he should not select a problem requiring large amounts of time.

4. The project should fit the student's interests and temperament. This is important in that self-motivation is a strong force.

One of the most frustrating experiences the student will likely encounter is selection of a problem or topic. There are numerous resources for the student to use in selecting a topic. Ideas may come from such sources as books, magazines, scientific journals, newspapers, research papers, one's own experiences, laboratory experiments, science clubs, television programs, resource people and agencies.

One of the better sources of ideas for problems and

topics is books produced specifically to meet this need. A bibliography of such materials is given on page 10.

Defining the Problem or Topic

A student will have to delimit his work quite specifically if he is researching a method of investigating a broad problem. One method of doing this is for the student to survey the available literature on the topic. This will familiarize the student with what is known about the topic and give him ideas of the methods he could use in investigating the problem. A written summary of the pertinent background information will be of invaluable assistance to the student as he progresses through his work. It will also give the teacher an opportunity to evaluate the work to date and see what avenues the student has left unexplored.

At this point the student could submit a project proposal.

The purposes of a proposal are:

1. To allow the teacher to comment on the feasibility and suitability of the problem or topic.
2. To appraise whether equipment and space is available.
3. To give the teacher an idea of literature and storage requirements.
4. To check time limits.
5. To give the student a clear outline of all the steps he must do and how he must do them.

A proposal is the outline of what a student plans, not what he has completed. Much guidance and discussion with the teacher may be required in its preparation. It should contain most of the following information:

1. A clear succinct statement of problem or topic,
2. The variable or variables being tested,
3. An hypothesis,
4. A step by step description of investigative procedures,

5. The amount and type of equipment required,

6. A procedural description of how data will be collected and recorded (charts, photographs, log book or diary).

An early deadline for submission of the proposal should be set so that problems that may arise with the investigation can be resolved. After the project proposal is approved the student may begin gathering data.

Collecting Data on the Problem or Topic

The teacher should make the student aware of the many ways of gathering observational and experimental data.

Observational data may be in the form of field or log book notes, drawings, moving or still pictures and tape recordings, to name a few possibilities. The student will have to be made aware of the specific techniques of each method of recording data. It is important for the student to realize that all possible data must be recorded as it is easy to forget significant details.

Experimental data, which either supports or rejects the hypothesis, may be quantitative in nature, thus being suitable for graphical presentation or simple statistical analysis.

The following outline could be presented to the student to assist in his gathering of experimental data.

(1) Specific facts required for some aspect of the problem or topic being researched may be unknown. This unknown information acts as the problem in the experiment. The student should be able to state his problem specifically in the form of a question to be answered. Quite often the student will have to review background information in journals, texts and research papers in order to better understand the problem. This will also provide possible clues for solving the problem.

(2) The student should develop a hypothesis. This tentative answer to the problem will usually give a clue as to the direction the investigation should take. Generally speaking, the hypothesis should be the simplest answer to the problem, as this makes for less complicated experimentation and easier interpretation of data. The hypothesis must be stated in a testable manner. If the hypothesis is stated in a way that cannot be tested, then it cannot be supported or refuted by the data collected.

(3) The student will develop a procedure which will produce data that will either support or refute the hypothesis. The procedure usually involves investigating variables experimentally and comparing the data with that collected from a controlled variable investigation. If all other conditions or events besides the one being tested are held constant, differences that occur between the control and experimental groups can be measured, recorded, compared and attributed to the condition that was manipulated. The condition or event tested is known as the variable factor. Its function is to test the hypothesis by setting up differences between the experimental groups that could give results for comparison. The similarities and differences that occur between the experimental groups must be recorded, as they form the results of the experiment.

(4) The results are analyzed in order to draw conclusions about the validity of the hypothesis. Data and results which have been recorded numerically can often be subjected to statistical analysis. This would determine whether the events recorded were due to chance or whether they were due to the variable being tested.

Should the results tend to support the hypothesis, it may be possible to form a conclusion. The conclusion should be accepted as being tentative until such time as it is possible to verify the results by repeating the experiment. Even if the results can be verified consistently, there is no assurance that the student has drawn the right conclusions from these results.

When results do not support the hypothesis, are inconclusive, or cannot be achieved with consistency when the experiment is repeated, the student will have to form either a new hypothesis or procedure to try to resolve the problem.

(5) The student should report on each experiment performed in order to have a clear, concise source of data for interpretation of the problem being studied.

Presentation of Projects

Students may present their projects either orally and/or as a written report.

If students are to present their projects as written reports, they should use scientific reporting procedures. The following format may assist students in making their reports.

5. The amount and type of equipment required,

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1. An introduction is given which states the problem clearly and provides the background of the problem. It should answer the five "w's": what, when, who, why and where.

2. The methods and materials used must be recorded. This should include information about the way the problem was approached, the type of apparatus used and the procedures used to gather data.

3. The results are presented as a record of the observational and experimental data collected.

4. The results should be interpreted in a discussion. Comments should be made on relevant results in the literature. This section is important and might form the largest portion of the report.

5. Acknowledgement should be given to those individuals who assisted in various ways.

6. A bibliography of the books used in completing the report must be included.

Set a suitable deadline for submission of written reports to allow time for evaluation.

Evaluating the Project

Evaluation of the project might be based on such items as:

(a) project proposal

(b) methodology and techniques used

(c) written reports, records and collections

(d) oral presentation

(e) teacher interview

(f) self-evaluation

(g) peer-group evaluation.

BIBLIOGRAPHY

Allen, D. *Research Projects in High School Biology.* Parker Publishing Co., Ltd., West Nyack, New York.

Analysis of Solids, Millipore Application Procedure 305. (Catalogue No. LA 306/u). Millipore Corporation, Bedford, Mass., 01730, 1971.

Andrews, Wm. A. (ed.). *Contours: Studies of the Environment Series.* Prentice-Hall of Canada, Ltd., 1870 Birchmount Road, Scarborough, Ontario.

Brainerd, J. W. *Nature Study for Conservation.* Collier-Macmillan Canada Ltd., 1125B Leslie Street, Don Mills, Ontario.

Brehman, T. R. *Environmental Demonstration: Experiments and Projects for the Secondary School.* Parker Publishing Co., Inc., West Nyack, New York.

BSCS. *Laboratory Blocks for Biology.* D. C. Heath, Ste. 1408, 100 Adelaide Street, W., Toronto, Ontario M5H 1S9.

1. *Animal Behaviour*
2. *Animal Growth and Development*
3. *Field Ecology*
4. *Life in the Soil*
5. *Physiological Adaptation*
6. *Plant, Growth and Development*
7. *Regulation in Plants by Harmonis, A Study in Experimental Design*
8. *The Complementarity of Structure and Function*

BSCS. *Investigating our Environment.*
Student Handbook.
Teacher Edition.
Addison-Wesley Publishing, 36 Andrew Place, Don Mills, Ontario, 1971.

Clark, E. *Fieldwork in Biology; An Environmental Approach.* Macmillan of Canada, 70 Bond Street, Toronto, Ontario M5B 1X3.

Giles, R. H. (ed.). *Wildlife Management Techniques.* Wildlife Society, Washington, D. C., 1969.

Hake, J. C., Jeffrey Baker, and G. E. Allen. *Twelve Problems in Biology; Open-ended Experiments for Introductory College Biology.* Addison-Wesley Publishing, 36 Andrew Place, Don Mills, Ontario, 1971.

Hechtlinger, Adelaide. *Handbook of Modern Experiments for High School Biology*. Parker Publishing Company, Inc., West Nyack, New York, 1971.

Hunter, Ronald C. and Henry C. Wohlers. *Air Pollution Experiments for Junior and Senior High School Classes*. Pittsburgh Air Pollution Control Association, Pittsburgh, Penn.

Kalmus, H. *One Hundred-One Simple Experiments on the Insects*. Doubleday, 105 Bond Street, Toronto, Ontario, 1953.

Moore, Shirley. *Science Projects Handbook*. Ballantine Books, 1960. New York.

Paetkau, P. *Projects Sourcebook for Life Science*. Doubleday Canada Ltd., 105 Bond Street, Toronto, Ontario, 1975.

Sankey, John. *A Guide to Field Biology*. Longman's Green and Co. Ltd., 55 Barber Green Road, Don Mills, Ontario, 1967.

Standard Methods for the Examination of Water and Wastewater. American Public Health Association, 1015 Eighteenth Street N.W., Washington, D.C., 20036, 1971.

Strobbe, Maurice, *Environmental Science Laboratory Manual*. C. V. Mosby Company, St. Louis, 1972.

Strong, C. L. *The Scientific American Book of Projects for the Amateur Scientist*, Simon and Schuster, New York, 1960.

Weaver, E. C. *Scientific Experiments in Environmental Pollution*. Holt, Rinehart and Winston, Inc., 55 Horner Avenue, Toronto, Ontario M8Z 4X6, 1968.

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